Practical 2\practical2.py

```python
import numpy as np

def fuzzy_union(A, B):
    return {x: max(A.get(x, 0), B.get(x, 0)) for x in set(A) | set(B)}

def fuzzy_intersection(A, B):
    return {x: min(A.get(x, 0), B.get(x, 0)) for x in set(A) & set(B)}

def fuzzy_complement(A):
    return {x: 1 - A[x] for x in A}

def fuzzy_difference(A, B):
    return {x: min(A.get(x, 0), 1 - B.get(x, 0)) for x in A}

def cartesian_product(A, B):
    return {(a, b): min(A[a], B[b]) for a in A for b in B}

def max_min_composition(R, S):
    result = {}
    for (x, y) in R:
        for (y2, z) in S:
            if y == y2:
                result[(x, z)] = max(result.get((x, z), 0), min(R[(x, y)], S[(y2, z)]))
    return result

# Example fuzzy sets
A = {'x1': 0.2, 'x2': 0.5, 'x3': 0.7}
B = {'x1': 0.6, 'x2': 0.4, 'x3': 0.8}
C = {'y1': 0.3, 'y2': 0.9}

# Performing operations
union_result = fuzzy_union(A, B)
intersection_result = fuzzy_intersection(A, B)
complement_result = fuzzy_complement(A)
difference_result = fuzzy_difference(A, B)

# Fuzzy relations
R = cartesian_product(A, C)
S = cartesian_product(C, B)
composition_result = max_min_composition(R, S)

# Display results
print("Union:", union_result)
print("Intersection:", intersection_result)
print("Complement:", complement_result)
print("Difference:", difference_result)
print("Cartesian Product (Relation R):", R)
print("Cartesian Product (Relation S):", S)
print("Max-Min Composition (R ∘ S):", composition_result)

```

Output

Union: {'x1': 0.6, 'x3': 0.8, 'x2': 0.5}
Intersection: {'x3': 0.7, 'x2': 0.4, 'x1': 0.2}
Complement: {'x1': 0.8, 'x2': 0.5, 'x3': 0.30000000000000004}
Difference: {'x1': 0.2, 'x2': 0.5, 'x3': 0.19999999999999996}
Cartesian Product (Relation R): {('x1', 'y1'): 0.2, ('x1', 'y2'): 0.2, ('x2', 'y1'): 0.3, ('x2', 'y2'): 0.5, ('x3', 'y1'): 0.3, ('x3', 'y2'): 0.7}
Cartesian Product (Relation S): {('y1', 'x1'): 0.3, ('y1', 'x2'): 0.3, ('y1', 'x3'): 0.3, ('y2', 'x1'): 0.6, ('y2', 'x2'): 0.4, ('y2', 'x3'): 0.8}
Max-Min Composition (R∘S): {('x1', 'x1'): 0.2, ('x1', 'x2'): 0.2, ('x1', 'x3'): 0.2, ('x2', 'x1'): 0.5, ('x2', 'x2'): 0.4, ('x2', 'x3'): 0.5, ('x3', 'x1'): 0.6, ('x3', 'x2'): 0.4, ('x3', 'x3'): 0.7}